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Congrid Eels of the Eastern Pacific and Key to Their Leptocephali

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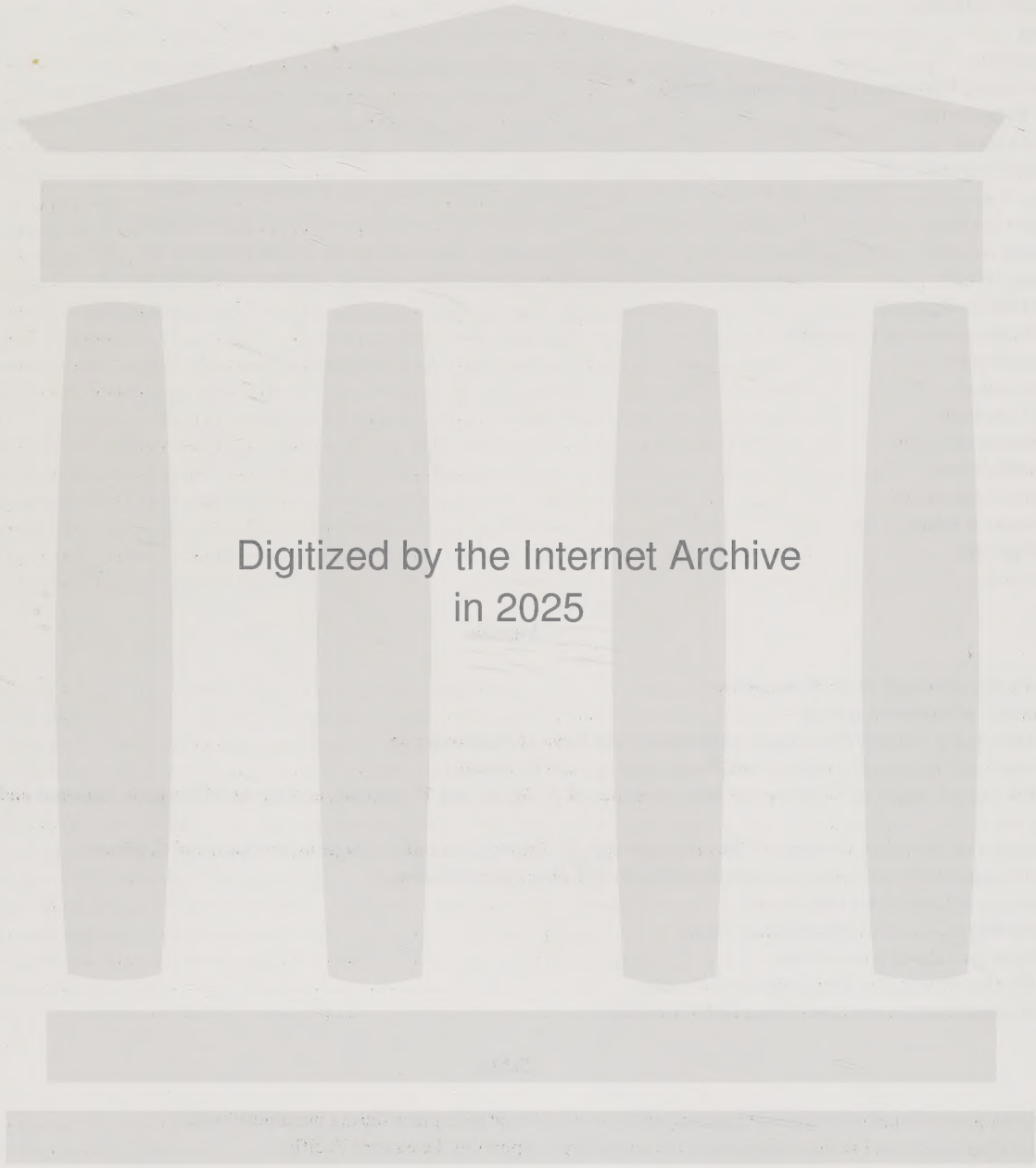

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Congrid Eels of the Eastern Pacific and Key to Their Leptocephali

SOLOMON N. RAJU[1]

ABSTRACT

This study indicates that 13 species of congrid larvae belonging to 8 genera occur in the eastern Pacific. The species are: *Ariosoma gilberti*; *Paraconger californiensis*; *Paraconger* sp.; *P. dentatus*; *Chiloconger labiatus*; *Taenioconger digueti*; *T. canabus*; *Gorgasia punctata*; *G. obtusa*; *Gnathophis catalinensis*; *Hildebrandia nitens*; *Bathycongrus macrurus*; and *B. varidens*. The morphological and anatomical changes undergone during metamorphosis are useful in the identification of the larvae. Larvae are distributed closer to the coastal waters, and are more common from January to May than from June to December. A key to the larvae was developed based on the myotomal counts, adult vertebral counts, pigmentation patterns, and the nature of the teeth and tail tip to distinguish the genera and species. This study shows that Garman's unidentified larvae, *Atopichthys acus* and *A. cingulus*, are two different larval stages of *Ariosoma gilberti*, and points out that *Atopichthys dentatus* and *A. obtusus* belong to *Paraconger* and *Gorgasia*, respectively.

INTRODUCTION

Eels of the family Congridae (except *Conger*) are usually small with moderately large pectoral fins and eyes and a slightly protruding upper jaw. They have a worldwide distribution in tropical and temperate waters and are essentially benthic or fossorial in habit. They form one of the most abundant and speciose families of eels. In the past, about 50 genera (including larval forms) were assigned to this family, but a recent study (Smith 1971) indicates that there may only be about 20 valid genera.

One problem in studying congrid eels is the limited availability of adults due to benthic and fossorial habit of most species; however, the larvae are easily collected in plankton nets, and in some cases help to predict the occurrence of unrecorded and unknown adults in that area. Such a prediction of the possible occurrence of two more species of *Paraconger* is made on the basis of this study.

The following congrid eels are known to occur in the eastern Pacific: *Ariosoma gilberti*, *Paraconger californiensis*, *Paraconger* sp., *P. dentatus*, *Chiloconger labiatus*, *C. similis*, *Congrosoma evermanni*, *Taenioconger digueti*, *T. canabus*, *Gorgasia punctata*, *G. obtusa*, *Gnathophis catalinensis*, *Hildebrandia nitens*, *Bathycongrus macrurus*, *B. varidens*, and *Ophisoma prorigerum*. This list also includes those which are predicted to be present on the basis of the presence of the larvae (e.g., *Paraconger* sp.).

The earliest account of the congrids of the eastern Pacific appears to be that of Jordan and Gilbert (1883), who gave a brief description of *Leptocephalus conger* (*Ariosoma gilberti*) from Cabo San Lucas. Important accounts of eastern Pacific congrids include those of Gilbert (1891), Ogilby (1898), Garman (1899), Meek and Hildebrand (1923), Pellegrin (1923), Myers and Wade (1941), Wade (1946), Rosenblatt (1958, 1967), Kanazawa (1961), Cowan and Rosenblatt (1974), and Raju (1974). Garman's (1899) account of the nine different congrid leptocephali and Wade's (1946) description of *Thyreoconger hemiaspidus* are the only accounts of congrid larvae of the eastern Pacific. This study is aimed at the identification, metamorphosis, and distribution of the larvae.

NOTES ON TAXONOMY AND DISTRIBUTION

Taxonomy

Congrid eggs are large like other eel eggs and were described by Grassi (1913), Thomopoulos (1956), Castle (1969a), and Castle and Robertson (1974). The egg described by Eigenmann (1902) as a conger eel egg was an ophichthid egg (Naplin and Obenchain 1980).

Early leptocephalus stages are usually 10-20 mm long, and are poorly preserved. In some cases the pigmentation is different from the full-grown leptocephalus stages (D'Ancona 1931; Castle 1964). Most congrid leptocephali attain an average length of 150 mm. *Ariosoma scheelei* (Castle 1964) and *Bathycongrus varidens* attain a length of 300 mm and 250 mm, respectively.

A trailing gut is present in the larvae of *Bathymyrus* and some species of *Ariosoma* (Smith 1979). My observations showed that the digestive glands are rudimentary in the leptocephalus stages and are devoid of any recognizable food. The gut shrinks in length during metamorphosis, the position of the anus shifts, and both the stomach and liver increase in size. The vent is shifted more anteriorly in large larvae than in small larvae. The changes in proportional measurements are given in Table 1.

I found in my study that the dorsal finfold is high in all genera except in the Heterocongrinae, and the segmented or unsegmented nature of rays can be seen only in late metamorphic and juvenile stages. The caudal fin is pointed in the larvae of *Hildebrandia nitens*, *Bathycongrus macrurus*, and *B. varidens*, and round in all the members of the *Congriscus* (Asano 1962), *Conger* (Smith 1979), and *Gnathophis*.

The diagnostic value of the eye in the Congridae (round in the Bathymyrinae and oval with a pigment patch below iris in the Congrinae) was pointed out by Castle (1964). Pigmentation, especially lateral pigmentation, is useful in identification of the congrid larvae. *Congriscus* (Asano 1962), *Conger* (except some

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Table 1.—Changes in proportional measurements of congrid leptocephali that take place during metamorphosis.

	Total length reduction (%)	Depth reduction (%)	Head increase (%)	Snout increase/ decrease (%)	Eye increase/ decrease (%)	Predorsal amplitude (%)	Preanal amplitude (%)	Number of specimens
Ariosoma gilberti	57.2	6.0	16.0	0.7	1.3	80.5	55.5	13
Paraconger californiensis	44.8	6.7	10.8	1.0	1.8	67.3	55.7	14
Taenioconger spp.	22.6	8.6	3.6	−1.0	0.3	15.7	46.0	9
Gorgasia punctata	20.0	8.2	3.0	−1.9	0.5	16.8	47.3	4
Gnathophis catalinensis	27.0	5.3	13.3	4.0	3.0	47.6	45.0	13
Hildebrandia nitens	34.3	8.4	9.7	2.2	0.5	29.0	64.0	14
Bathycongrus macrurus	42.6	5.0	5.5	1.0	1.7	55.6	64.0	14
Bathycongrus varidens	54.4	6.3	16.5	2.5	1.7	67.5	59.3	15

species, Smith 1979), and *Gnathophis* larvae lack lateral pigmentation. *Parabathymyrus* (Smith 1979) and *Ariosoma* larvae have lateral pigmentation in oblique rows on myosepta. A single row of midlateral pigment is present in *Paraconger*, *Chiloconger*, *Taenioconger*, *Nystactichthys*, *Gorgasia*, *Hildebrandia*, and *Bathycongrus macrurus* studied by me, and in some species of *Rhechias* and *Uroconger* studied by Smith (1979). Three rows of lateral pigment spots are present in *Rhechias guttulata* (Smith 1979) and *Bathycongrus varidens* (present account). *Leptocephalus splendens* (Lea 1913), which was identified as the larva of *Pseudophichthys* (Smith 1979), has three irregular midlateral rows of pigment and large patches of pigment below the midlateral line. Lateral pigmentation persists into the juvenile stages in *Paraconger*, *Taenioconger*, *Nystactichthys*, and *Bathycongrus* studied by me, and in *Rhechias* and *Pseudophichthys* studied by Smith (1979).

Seasonal Distribution and Relative Abundance

Table 2 shows the relative abundance of the different species in different months of the year, but this may not give the correct picture of the actual distribution in the ocean, as samples were not collected systematically. Nevertheless, it does portray a rough picture of the relative abundance of different species. The number of leptocephali of many species is usually very high in May. Leptocephali are more common from January to May than from June to December.

MATERIALS AND METHODS

Specimens

The study is based on about 4,000 leptocephali, metamorphic larvae, juveniles, and adults of the congrids of the eastern Pacific. Most of the material studied came from the Scripps Institution of Oceanography, collected over a period of 20 yr from the following cruises: CalCOFI (1950, 1961, 1964), Northern Holiday Expedition (1951), Shellback (1952), Pelagic Area Survey (1954), EASTROPAC (1955, 1967), Tuna Spawning Survey (1957), Tuna Oceanography-58-2, Tuna Oceanography-59-1, and Vermilion Sea Expedition (1959). Material from the Los Angeles County Museum of Natural History, University of California at Los Angeles, University of Southern California, and the National Marine Fisheries Service at La Jolla, was also used to find metamorphic forms and station data for distribution. Material at the National Museum of Natural History, Washington, DC; Smithsonian Oceanographic Sorting Center, Washington, DC; American Museum of Natural History, New York; Woods Hole Oceanographic Institution; and the British Museum of Natural History, London, was examined for the purpose of identification and comparison.

Most of the specimens and the station data are available for reference in the fish collections of the Scripps Institution of Oceanography, La Jolla, and Los Angeles County Museum of Natural History. Two published catalogues on zooplankton samples (Snyder and Fleminger 1965, 1972) will also provide most of the station data. Almost all material comes from the area ranging from southern California to Colombia. The terms used for the description of the larvae are after Castle (1963).

Identification

Larvae were identified by tracing characteristics of juveniles and metamorphic forms backwards to the larval forms. Adults were studied in most cases, and their vertebral counts and other morphological characteristics were taken into consideration to establish the identities. Metamorphic forms, juveniles, and adults were also dissected to study the anatomy.

Table 2.—Seasonal distribution and relative abundance of congrid leptocephali in the eastern Pacific.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Ariosoma gilberti	141	72	8	90	264	75	8	0	0	3	40	19	720
Paraconger californiensis	137	20	3	25	328	169	1	0	1	0	28	0	712
Paraconger dentatus	9	3	0	2	28	0	0	0	0	0	46	0	88
Paraconger sp.	0	0	0	1	5	0	1	1	1	0	0	1	10
Taenioconger spp.	13	3	0	750	5	82	3	4	0	0	0	0	860
Gorgasia punctata	0	0	0	3	0	0	0	0	0	0	0	0	3
Gnathophis catalinensis	2	11	0	11	0	10	6	1	2	7	4	0	54
Hildebrandia nitens	120	32	35	54	527	326	44	5	10	2	62	0	1,217
Bathycongrus varidens	0	15	0	0	15	26	3	3	0	0	0	0	62
Bathycongrus macrurus	2	1	0	2	1	1	0	0	0	0	0	0	7
											Grand total		3,733

Measurements (Table 1)

Measurements of total length, body depth, head, and predorsal and preanal distances were taken with dial calipers, and those of snout, eye, and other small structures with an ocular micrometer. The values are rounded to the nearest millimeter. The descriptions given in the text under each species apply to the leptocephalus stages but not to the metamorphic and juvenile stages. The percentage of depth and head were calculated from the total lengths, and those of the snout and eye from the head length. The percentage of total length reduction after metamorphosis was calculated by subtracting the total length of the metamorphosed (smallest specimen) form from the length of a full-grown (largest premetamorphic) form, the percentage being computed in terms of the total length of the full-grown form. The percentage of depth reduction and snout increases or decreases were calculated as above. In *Gnathophis catalinensis*, a juvenile form is used in place of a metamorphic form for measurements since no metamorphic form of *G. catalinensis* was available.

The amplitude of the dorsal fin is the distance moved by the dorsal fin from its original point before metamorphosis to its point at metamorphosis. The percentage amplitude of the dorsal fin is calculated as follows: The percentage of the predorsal distance of the metamorphic form is subtracted from the percentage of predorsal distance of the full-grown larva. The percentage amplitude of the anal fin is also calculated as above.

Methods of Collection

Leptocephali were collected by Isaacs-Kidd Midwater Trawl, midwater trawl, universal trawl, otter trawl, bottom trawl, nekton net (5′ × 5′), Hansen Net, meter net (1 m), and dip net; metamorphic forms were collected by using rotenone and dredges.

Drawings

Drawings were made by using a camera lucida and an overhead projector.

Abbreviations

SIO = Scripps Institution of Oceanography, LACM = Los Angeles County Museum of Natural History, UCLA = University of California at Los Angeles, NMFS = National Marine Fisheries Service, La Jolla, CA, TL = Total length, ETP = EASTROPAC, TS = Tuna survey.

KEY TO THE CONGRID LEPTOCEPHALI OF THE EASTERN PACIFIC

1a. Tail tip blunt and round 2
1b. Tail tip pointed 10
2a. No lateral pigment, black patch below iris, myotomes 128-132 ..... *Gnathophis catalinensis*
2b. Lateral pigment as single row on lateral line or as an oblique row on myosepta, no black patch below iris 3
3a. Teeth conical, few, not compressed 4
3b. Teeth laterally compressed, bladelike, numerous 8
4a. Lateral pigmentation on myosepta as a series of oblique lines, snout moderate size, myotomes 126-138 ..... *Ariosoma gilberti*
4b. Lateral pigmentation as a single row of midlateral melanophores, snout short, myotomes 138-199 5
5a. Myotomes more than 170, caudal fin narrow 6
5b. Myotomes less than 170, caudal fin broad 7
6a. Myotomes 170-191 (with mode around 185), body pigmentation as patches in late metamorphic larvae ... . (?) *Taenioconger digueti*
6b. Myotomes 186-208 (with mode around 192), body pigment uniform as minute spots in late metamorphic larvae ..... (?) *Taenioconger canabus*
7a. Myotomes 119-121 ..... *Gorgasia obtusa*
7b. Myotomes 138-156 ..... *Gorgasia punctata*
8a. Maximum TL 250 mm, myotomes 150-162, one midlateral dot for every 5-10 myotomes ..... *Paraconger* sp.
8b. Maximum TL not greater than 165-170 mm, myotomes 118-146, midlateral dot on every myotome or absent on some myotomes 9
9a. Body size moderate, attains 165-170 mm, myotomes 138-146, midlateral dots lacking on some myotomes... ..... *Paraconger californiensis*
9b. Body small, attains 120-125 mm, myotomes 118-124, midlateral dots on every myotome .... *Paraconger dentatus*
10a. Lateral pigment superficial as three rows of dots, maximum TL 250 mm ..... *Bathycongrus varidens*
10b. Lateral pigment superficial or internal in the form of a single midlateral row of dots, maximum TL 160-170 mm 11
11a. Midlateral row of dots superficial, no pigment dots on upper jaw ..... *Bathycongrus macrurus*
11b. Midlateral row of dots internal, 1-3 pigment dots on upper jaw ..... *Hildebrandia nitens*

SUBFAMILY BATHYMYRINAE

Ariosoma gilberti (Ogilby 1898)
Figures 1, 2

Literature.—The synonymy of this species was given by Rosenblatt (1958). Larvae of this species were described by Garman (1899) as *Atopichthys acus* and *A. cingulus*. These two specimens are different stages of *Ariosoma gilberti*. Larvae of *Ariosoma* spp. have been described by various authors (Castle 1964; Blache 1977; Smith 1979).

Identification.—The oblique series of closely packed, microscopic, linear melanophores are characteristic of all *Ariosoma* spp. The melanophores on the myosepta disappear with the onset of metamorphosis and can lead to incorrect identification. The vertebral counts of *Ariosoma gilberti* (47-50) + (77-89) = 124-139 agree with the larval myotomal counts (126-138). The dorsal and anal fin ray counts of metamorphic forms agree with those of adults.

Material Examined.—611 specimens, 83-206 mm TL. Baja California and Gulf of California: SIO 59-201(1), 60-276(1), 61-21(1), 64-12(1), 64-13(1), 64-15(1), 64-16(2), 64-23(1), 64-26(4), 64-27(8), 65-236(2), 65-253(4), 68-50(10), 68-132(5), 63-818(1), 63-865(21), 75-551(1), 63-933(12), 75-546(1), 75-564(7), 75-565(2), 75-566(10), 63-973(2), 63-975(5), 63-978(2), 63-616(62), 63-866(3), 60-7(1), 61-249(1), 64-27(2), 65-253(5), 65-564(1), 68-50(10), 68-132(4), 60-111(1), 62-77(2), 62-702(1), 62-709(2), 60-89(1), 59-261(1). Mexico: SIO 54-91(1), 54-92(1), 63-509(1), 73-249(13), 63-819(2), 63-822(1), 63-823(2), 63-824(3), 63-861(20), 63-864(20), 63-857(9), 63-922(2),

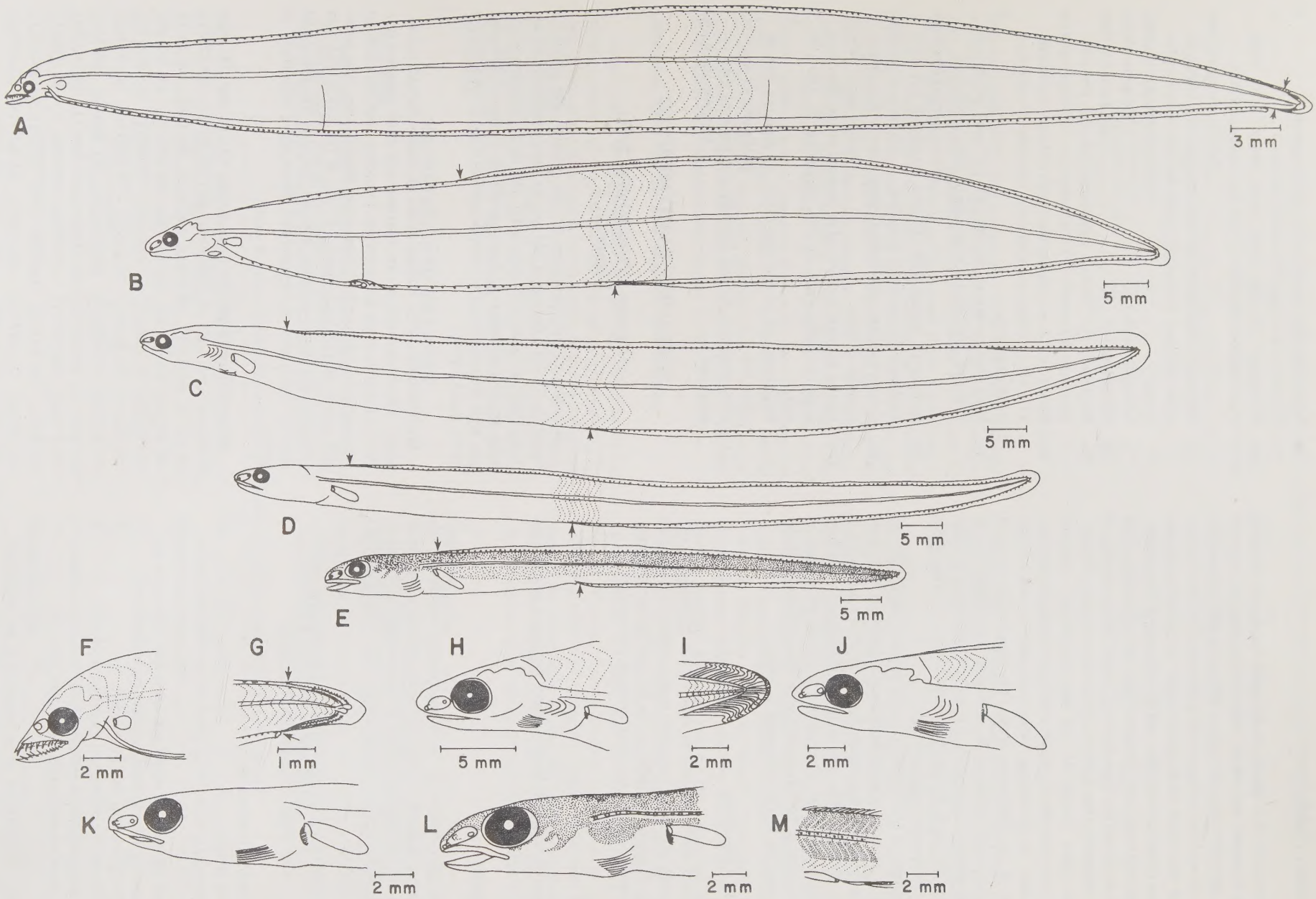

Figure 1.—Early life history stages of *Ariosoma gilberti*. A. Fullgrown larva; B. early metamorphic form; C. late metamorphic form; D. early juvenile; E. late juvenile; F. head of full grown larva; G. caudal end of fullgrown larva; H. head of early metamorphic form; K. head of early juvenile; L. head of late juvenile; M. body segment of late juvenile.

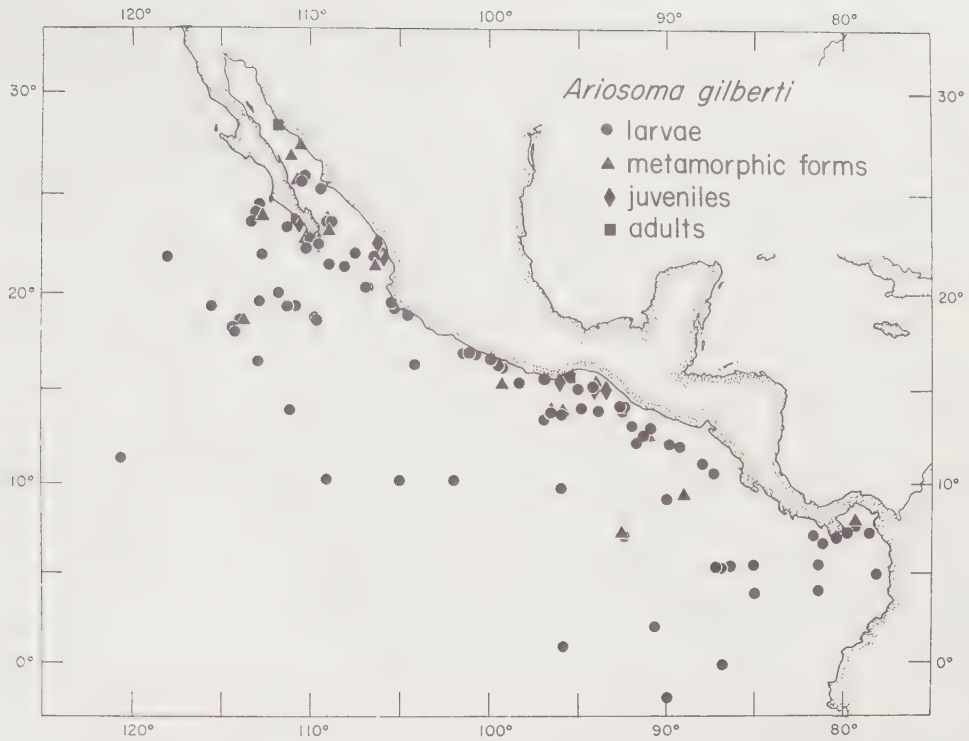

Figure 2.—Distribution of *Ariosoma gilberti* based primarily on SIO collections.

63-924(2), 63-923(15), 63-932(69), 63-930(2), 63-931(13), 75-544(1), 75-542(6), 75-545(1), 63-973(2), 63-913(2), 63-510(2), 63-509(1), 63-521(2). Central America: SIO 55-213(1), 53-138(1), 58-422(1), 63-826(7), 63-829(2), 63-835(24), 63-75(4), 62-640(12), 63-839(36), 63-858(8), 63-854(11), 63-851(14), 63-853(52), 63-852(21), 63-856(15), 63-855(8), 63-927(3), 63-929(8), 63-524(5), 64-198(4), 66-458(1), 73-263(23), 75-554(12), 75-556(4), 75-559(2), 75-560(3). Colombia: SIO 62-387(1), 55-246(3), 55-247(3), 55-258(3), 63-838(5), 63-841(1), 63-842(1), 63-843(4), 63-848(9), 63-849(1), 63-845(3), 63-846(1), 69-8(2), 63-299(1), 63-1022(1).

Description (based on 13 specimens, 83-206 mm TL).—Body elongate; an oblique series of closely packed, superficial, linear, microscopic melanophores on midlateral myosepta ranging from 1 to 30, beginning at myotome 5; a series of round superficial melanophores on the dorsal side beginning at myotome 7 to origin of dorsal; a paired series of superficial melanophores on the ventral side beginning from level of pectoral fin to level of stomach; a series of linear, internal melanophores on dorsal side of intestine from level of stomach to vent. One dotlike internal melanophore at the base of each anal and dorsal ray. Preanal distance 94-96%; predorsal distance 96%; head 2-3%; greatest depth 9-11%; total myotomes 126-138; preanal myotomes 121-128; last blood vessel at myotome 26-27; caudal rays 6; tooth formula $\frac{1+(4-5)+(6-8)}{1+(4-6)+(6-9)}$.

Metamorphic Forms and Juveniles (Table 1).—Metamorphosis sets in when the larvae are about 200 mm long and the pigmentation on the myosepta disappears abruptly. The juvenile pigmentation appears as very small brown chromatophores on the dorsal and lateral sides, and becomes denser in the later stages. No black pigment is present on the viscera.

The total length reduction (57.2%) and increase in head length (16.0%) and predorsal amplitude (80.5%), are the highest among the 13 species studied. The increase in snout length (0.7%) and decrease in body depth (6.0%) are moderate.

Abundance.—The leptocephali of *A. gilberti* are among the most abundant in the larval eel collections of the eastern Pacific.

Distribution (Fig. 2).—The larvae occur over a large area of the tropical and temperate regions of the eastern Pacific (lat. 28°41′N to the Equator, and from the Gulf of Panama to long. 120°57′W). The distribution map shows the occurrence of the larvae in the offshore waters and the metamorphic forms in the near shore. Presumably the larvae, after being swept away by the currents, will begin to move toward coastal regions after metamorphosis and settle down to begin their fossorial life.

Larvae were obtained throughout the year except in August and September; the maximum numbers were obtained in May and January (Table 2). Metamorphic forms were obtained in January, February, May, June, and November; the maximum number collected was in May.

Discussion.—*Atopichthys acus* (127 + 8 = 135 myotomes) and *Atopichthys cingulus* of Garman (1899) are assigned to *Ariosoma gilberti* on the basis of myotomal counts and pigmentation. Castle (1964) suggested that *Atopichthys dentatus* and *A. obtusus* of Garman belong to *Ariosoma gilberti*. I have assigned *Atopichthys dentatus* to *Paraconger* and *Atopichthys obtusus* to *Gorgasia* on the basis of myotomal counts and pigmentation. The adults of the Indo-West Pacific species, *Ariosoma scheelei* and *A. mauritianum*, were also suggested to be synonymous with *A. gilberti* by Castle. The myotomal count of *A. scheelei* (115) is lower and that of *A. mauritianum* (134-153) is higher than the myotomal count of *A. gilberti* (126-138).

Paraconger californiensis Kanazawa 1961
Figures 3, 4

Literature.—One of the distinguishing features of *Paraconger* is the compressed teeth that form a cutting edge, a characteristic shared by their larvae. Of the six species reported by Kanazawa (1961), only *P. californiensis* is known to occur in the eastern Pacific. Castle (1966, 1970), Blache (1977), and Smith (1979) identified and described larvae of *Paraconger* from the Atlantic. Larvae of *P. californiensis* are identified here for the first time, and the larvae of another new species of *Paraconger* are described.

Identification.—Identification of the larvae was made with the help of metamorphic forms which retained the larval midlateral pigmentation. The myotomal counts of the larvae agreed with those of the metamorphic forms and with the vertebral counts (137-148) of juveniles and adults. The larval teeth are characteristically compressed. The absence of the crescentic patch of pig-

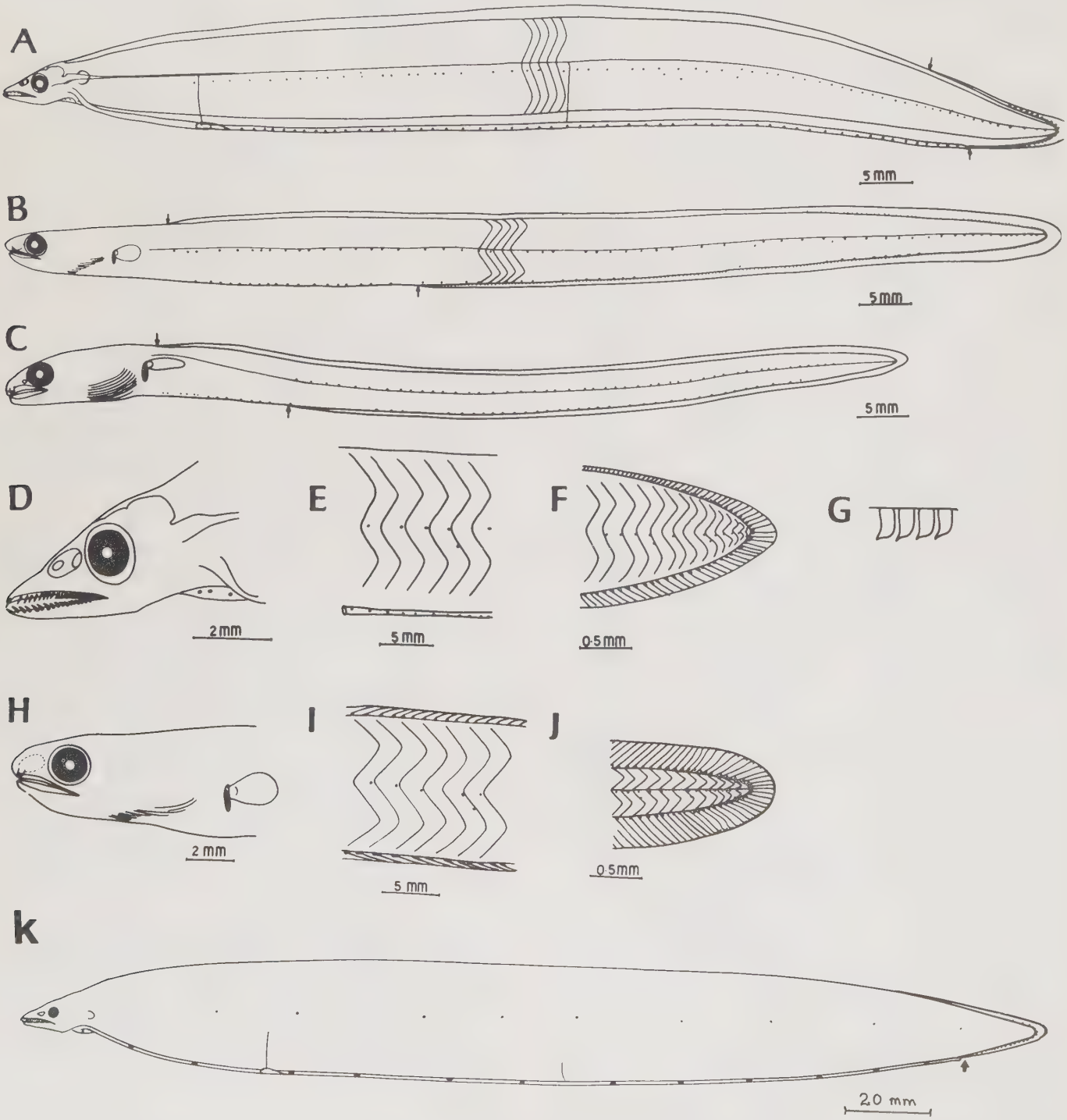

Figure 3.—Early life history stages of *Paraconger californiensis* and larva of *Paraconger* sp. A. Fullgrown larva; B. early juvenile; C. late juvenile; D-F. head, midbody, caudal end of fullgrown larva; G. teeth; H-J. head, midbody, caudal end of early juvenile; K. fullgrown larva of *Paraconger* sp.

ment under the eye, blunt tail fin, and unsegmented fin rays help to assign these larvae to the Bathymyrinae, and the compressed teeth refer them to *Paraconger*.

Material Examined.—191 specimens, 60-165 mm TL. Gulf of California and Mexico: SIO 63-616(6), 63-933(2), 63-921(1), 63-818(1), 63-864(1 metamorphic), 63-922(1), 63-932(4), 73-235(1), UCLA W-52-12(2 metamorphic), W-57-116(1 metamorphic), SIO 73-249(13), 63-931(3), 63-76(3), 63-930(6), 63-961(2), 73-263(12), 63-834(21), 63-858(53), 63-925(5), 75-556(13), 63-852(2), 63-927(1), 63-836(1), 63-839(1). Colombia: SIO 55-249(7), 55-242(26), 61-421(1), 62-387(1).

Description (based on 14 specimens, 60-165 mm TL).—Body elongate; a series of dotlike melanophores on most myotomes on midlateral line beginning at myotome 10; a series of paired melanophores on ventral side beginning at stomach bulge to end of body; a series of small melanophores at base of anal, caudal, and dorsal fin rays; a series of 3-4 melanophores in heart region. Preanal distance 89-90%; predorsal distance 80-84%; head 5-8%; greatest depth 7-12%; total myotomes 135-143; preanal myotomes 104-120; last blood vessel at myotome 54-57; caudal rays 4 + 3 = 7; teeth compressed; tooth formula $\frac{1+(9-10)+(26-36)}{1+(10-13)+(18-22)}$.

Metamorphic and Juvenile Forms (Table 1).—Larval pigmentation on the midlateral line and ventral side are retained in early juvenile stages but disappear in late juvenile stages. Juvenile pigmentation appears as minute brown dots all over the body, and the margin of the median fins becomes black. Only the rectum develops brown pigment.

The reduction (44.8%) in total length is high. The increase (10.8%) in the head length, predorsal (67.3%), and preanal (55.7%) amplitudes is also high.

Distribution (Fig. 4).—The larvae of *P. californiensis* are distributed along the coast from Cabo San Lucas to Panama; the adults extend to Peru (Kanazawa 1961). Larvae were collected in all months of the year except August, October, and December; the maximum number collected was 328 in May. Metamorphic forms were collected in January and April, and juveniles were collected in March. Larvae were abundant.

Paraconger sp.
Figures 3K, 4

Literature.—This larva has not previously been reported or described.

Identification.—The larvae were identified as belonging to *Paraconger* on the basis of the compressed teeth and midlateral pigmentation. They differ from the larvae of *P. californiensis* in higher myotomal count (150-167), larger size (127-250 mm TL), and sparse midlateral pigmentation. Since no adults of *Paraconger* with a vertebral count of 150-167 are known, these larvae are provisionally assigned to *Paraconger* sp., which is possibly a new species of the eastern Pacific.

Material Examined.—14 specimens, 93-245 mm TL. Mexico to Colombia: SIO 75-563(1), 63-850(1), 63-838(1), 63-841(1), 62-639(1), 60-580(1), 62-387(1), 63-1081(1), 55-265(1), 75-534(1), NMFS ETP 11.114(2), 11.246(1), 11.098(1).

Description (based on 11 specimens, 93-245 mm TL).—Body elongate; a series of dotlike melanophores on many myotomes on midlateral line beginning at myotome 10-12; a series of paired

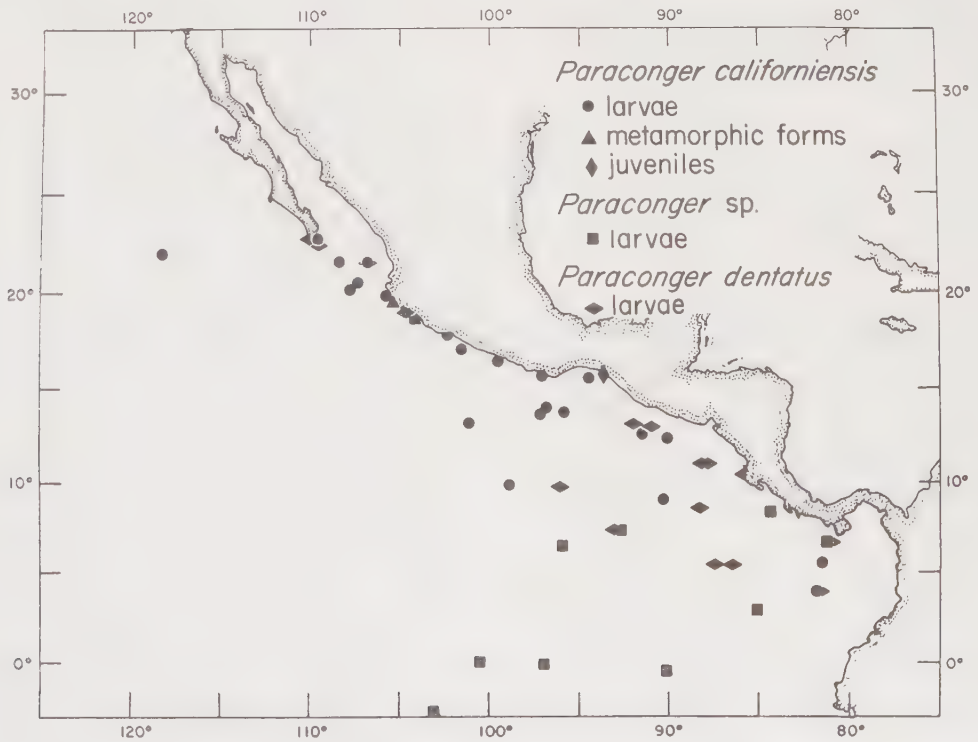

Figure 4.—Distribution of *Paraconger californiensis*, *Paraconger* sp., and *Paraconger dentatus* based primarily on SIO collections.

melanophores beginning at stomach bulge to end of body; a series of small melanophores at base of anal, caudal, and dorsal fin rays; a series of 3-4 melanophores in heart region. Preanal distance 91-95%; predorsal distance 84-88%; head 5-6%; greatest depth 9-11%; total myotomes 150-167; preanal myotomes 130-142; last blood vessel at myotome 65-68; teeth compressed; tooth formula $\frac{1+(8-9)+(28-50)}{1+(12-17)+(20-40)}$.

Metamorphic Forms.—The midlateral pigmentation becomes inconspicuous in metamorphic forms (due to contractions of the melanophores) and probably disappears in the juveniles. No juveniles were obtained. The metamorphic forms obtained were in very early stages and no significant changes in body proportions were noticed.

Distribution (Fig. 4).—The larvae are mostly confined to the offshore waters of Costa Rica and Panama. Of the three species of *Paraconger*, this species has the most southerly distribution, extending beyond the Equator. Larvae were collected in April, May, July, August, September, and December; the maximum number collected was 5 in May. Metamorphic forms were obtained in November. Larvae are rare in the collections.

Paraconger dentatus (Garman) 1899
Figure 4

Literature.—Castle (1964) suggested that *Atopichthys dentatus* is possibly the larva of *Ariosoma gilberti*. Larval features, however, suggest that this is not the larva of *Ariosoma*.

Identification.—The compressed teeth and midlateral pigmentation show that this larva belongs to *Paraconger*. It differs from the larvae of *P. californiensis* and *Paraconger* sp. in having a lower myotomal count (109-125), irregular midlateral pigmentation, and relatively smaller size (40-125 mm TL). The characteristics of the larvae agree with those of *A. dentatus* of Garman.

Material Examined.—84 specimens, 40-125 mm TL. Mexico to Colombia: SIO 68-50(8), 63-616(2), 63-922(1), 63-929(1), 73-263(2), 63-851(5), 55-235(1), 62-640(2), 75-558(1), 63-848(3), 63-838(3), 63-849(2), 63-841(1), 63-843(4), 63-845(5), 55-242(39), 55-249(4).

Description (based on 11 specimens, 40-125 mm TL).—Body elongate; a series of midlateral melanophores on myotomes which are more regular than in *P. californiensis*. Pigment spots at base of anal and dorsal rays absent in some specimens. Preanal distance 83-95%; predorsal distance 57-95%; head 6-10%; greatest depth 9-12%; total myotomes 109-125; preanal myotomes 98-109; last blood vessel at myotome 44-50; teeth compressed; tooth formula $\frac{1+(8-11)+(15-30)}{1+(10-16)+(9-16)}$.

Metamorphic and Juvenile Forms.—No metamorphic or juvenile forms were obtained.

Distribution (Fig. 4).—The larvae show an intermediate position in distribution between *P. californiensis* and *Paraconger* sp., and are mostly distributed off the Pacific coast of Guatemala, El Salvador, and Nicaragua, although some have been found near Cabo San Lucas. Larvae were obtained in January, February, April, May, and November; the maximum number collected was 46 in November. The larvae were not abundant.

Chiloconger labiatus Myers and Wade 1941
(Not illustrated)

Myers and Wade (1941) described this species from a very early juvenile of 83.0 mm which retained the larval pigmentation. The authors did not distinguish the larval pigmentation from that of the juvenile. A description of the remnant larval pigmentation and myotomal and vertebral counts are given here to help future identification of the larvae of *Chiloconger*.

Larval pigmentation: A series of dotlike midlateral, superficial melanophores beginning at myotome 15 and extending to the caudal end. A series of microscopic melanophores at the base of median fin rays. Two melanophores on ventral side.

Juvenile pigmentation: Dorsal and lateral sides uniformly covered with brown dots as described by Myers and Wade.

Vertebral counts: *Chiloconger labiatus*, 39 + 83 = 122. Myotomes 42 + 84 = 126.

Chiloconger similis Wade 1946

Wade (1946) described *Chiloconger similis* from the eastern Pacific. The vertebral count of this species is given here to facilitate identification of the larvae. Vertebral counts 50 + 96 = 146.

SUBFAMILY HETEROCONGRINAE

Taenioconger digueti Pellegrin 1923 and *Taenioconger canabus* Cowan and Rosenblatt 1974
Figures 5 A-D, 6

Literature.—The literature, description, and distribution of the larvae of *Taenioconger* were given in an earlier account (Raju 1974). Subsequently, Cowan and Rosenblatt (1974) described a new species, *T. canabus*, from the eastern Pacific. The above authors synonymized *T. herrei* Wade with *T. digueti* in their account. A part of the information of the previous account (Raju 1974) is included in this paper for the purpose of comparison and to supplement the material on congrid larvae. As the previous description was based on a single specimen, a redescription of the *Taenioconger* larvae based on several specimens is given.

Identification.—The larvae closely resemble those of *Paraconger* and *Hildebrandia* in general appearance and the midlateral pigmentation. They can be distinguished from the *Paraconger* larvae by higher myotomal count, smaller conical teeth, shorter snout, longer dorsal fin, and shorter gut. The larvae of *Hildebrandia* differ from those of the *Taenioconger* in having a whiplike tail, deep midlateral melanophores, and fewer myotomes.

Taenioconger larvae of the eastern Pacific have 170-208 myotomes. Cowan and Rosenblatt (1974) separated *T. digueti* (vertebral count 179-191) from *T. canabus* (vertebral count 186-199) on the basis of vertebral counts, pigmentation, and other features. The larvae could not be assigned to either of the two species due to overlapping of the myotomal counts. The myotomal counts have a mode around 185 or 192 in most larvae.

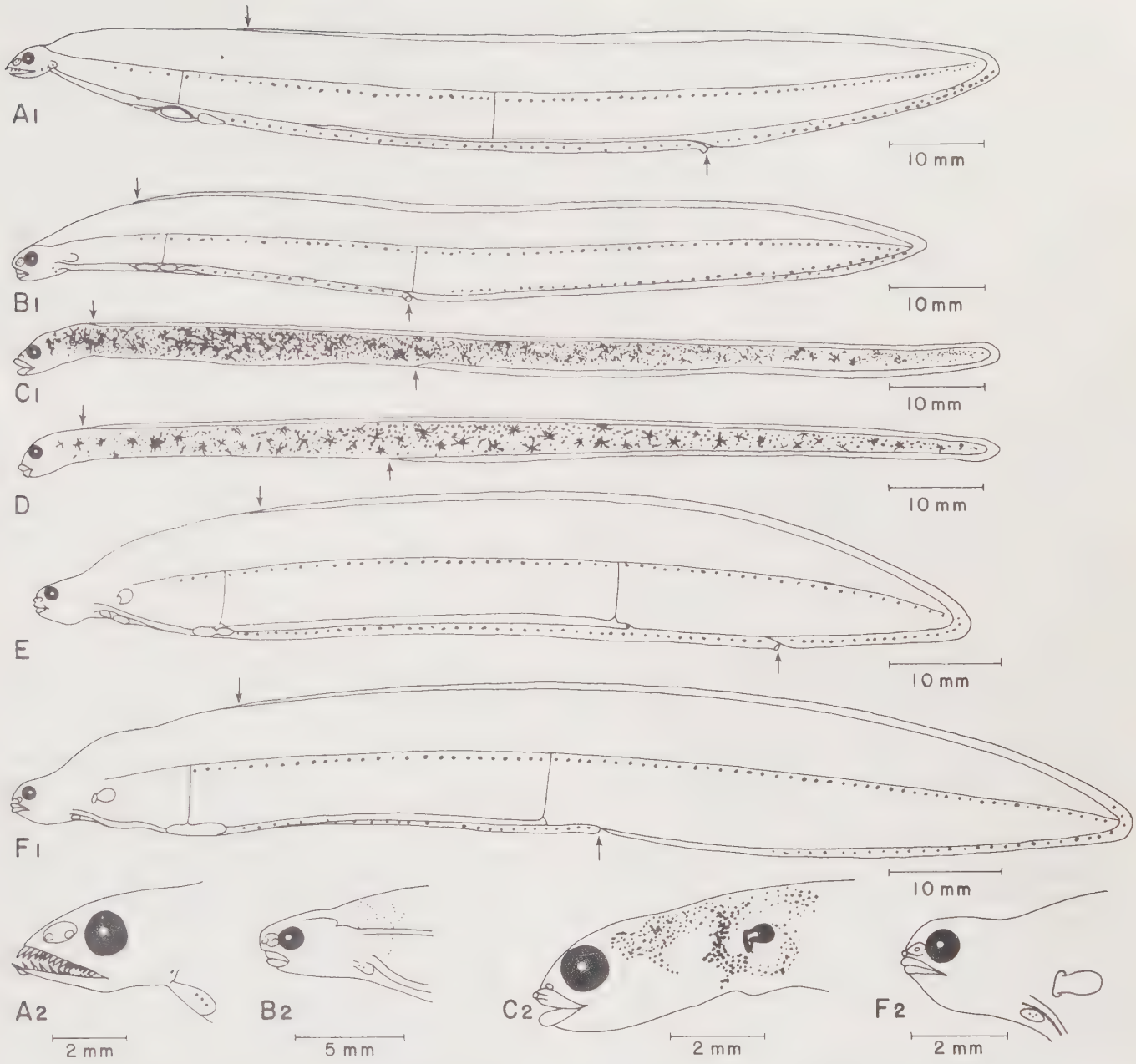

Figure 5.—Early life history stages of *Taenioconger* spp., juveniles of *T. digueti* and *T. canabus*, and larvae of *Gorgasia punctata* and *G. obtusa*. A_1, A_2. Larva and head of *Taenioconger* sp.; B_1, B_2. larva and head of early metamorphic form of *Taenioconger* sp.; C_1, C_2. larva and head of early juvenile of *T. digueti*; D. early juvenile of *T. canabus*; E. fullgrown larva of *Gorgasia punctata*; F_1, F_2. larva and head of *Gorgasia obtusa*.

Postmetamorphic forms can be distinctly separated by their early juvenile pigmentation. The body pigmentation of the early juveniles of *T. digueti* has a patchy pattern, whereas it is uniform in *T. canabus*.

Material Examined.—*Taenioconger* sp. (larvae), 970 specimens, 68-115 mm TL. Gulf of California to Galapagos Islands: SIO 62-14(4), 62-639(1), 63-616(70), 63-856(2), 63-859(3), 63-861(3), 63-864(5), 63-920(1), 63-921(2), 63-922(8), 63-932(3), 63-960(1), 65-253(1), 68-54(2), 74-249(750), TS 63(1), TS 5407P-15(1). *Taenioconger digueti* (juveniles and adults), 100 specimens, 110-180 mm TL. SIO 62-42(100). *Taenioconger canabus* (juveniles and adults), 121 specimens, 90-284 mm TL. SIO 61-261(50), 62-42(11), 72-41(60).

Description of the Larvae of *Taenioconger* sp. (based on 8 specimens, 87-115 mm TL).—Body elongate; a series of mid-lateral melanophores beginning at myotome 15-20 to end of caudal region; a series of melanophores on ventral side beginning at myotome 10-13 and continuing to end of body; a series of 4-5 melanophores in heart region; a series of very fine melanophores at base of anal and dorsal rays; 1-2 melanophores at angle of jaws in some. Preanal distance 66-76%; predorsal distance 21-30%; head 5-7%; greatest depth 9-12%; total myotomes 170-208;

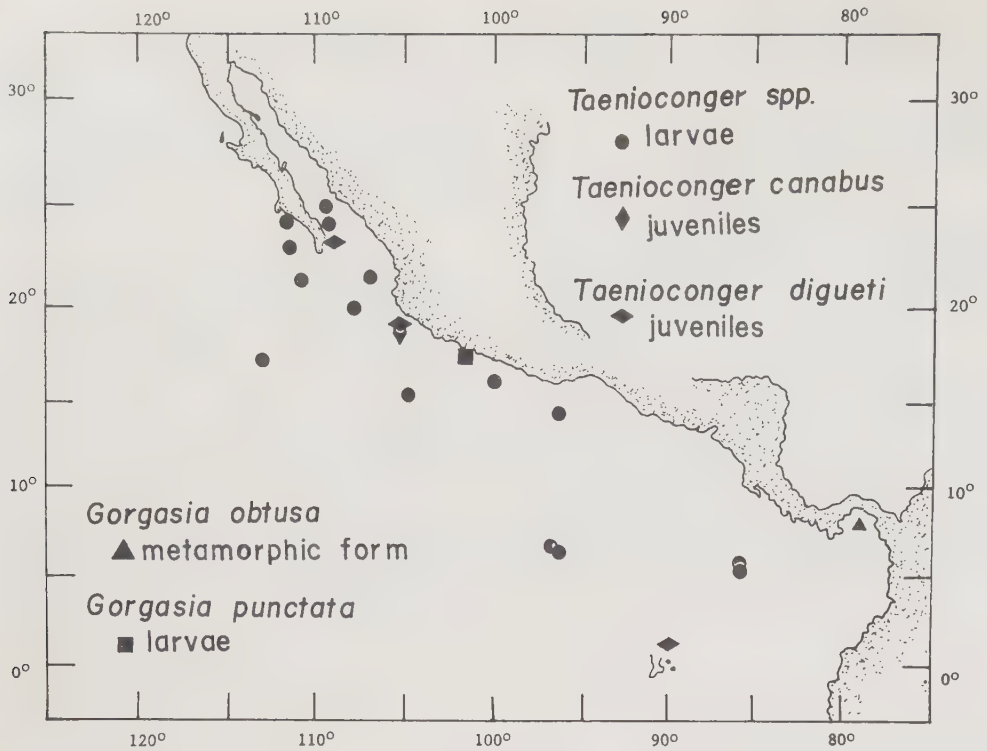

Figure 6.—Distribution of larvae and juveniles of *Taenioconger* spp., *T. digueti*, *T. canabus*, *Gorgasia punctata*, and *G. obtusa* based primarily on SIO collections.

preanal myotomes 115-130; last blood vessel at myotome 64-78; caudal rays 4 + 3 = 7; tooth formula $\frac{1+(7-10)+(10-24)}{1+(8-9)+(6-12)}$.

Metamorphic and Juvenile Forms (Table 1).—One of the late metamorphic forms of *T. canabus* (108 mm TL) was very transparent and cylindrical, and the pectoral fins were clear without any pigmentation. The body pigmentation was uniform with stellate melanophores on the head and lateral side of the body. Advanced stages of this species have black pectorals and a thick uniform pigment on the body. The pigment in *T. digueti* (110 mm TL) has a patchy pattern.

The reduction (22.6%) in total length is small, but the reduction (8.6%) in body depth is higher. The increase in head length (3.6%) and the eye (0.3%) are among the lowest. The snout length (−1.0%) is even smaller than that of the full-grown larva.

Distribution (Fig. 6).—The larvae are distributed between lat. 00°12′53″S and 23°53′N, and long. 111°39′W and 86°43′W. Larvae were collected from January to February, and from May to July; the maximum number collected was in April. Metamorphic forms were collected in January, and juveniles in August. The larvae spread out farther from the coastal region than the juveniles and adults.

Gorgasia punctata Meek and Hildebrand 1923
Figures 5E, 6

Literature.—The literature and the description of *Gorgasia* were given in a previous account (Raju 1974). Although the adults of *G. punctata* from the eastern Pacific have been known for a long time, their larvae have not been previously identified.

Identification.—Larvae were identified by tracing the characteristics of the juveniles of *G. punctata* back to the larval stages. The early juveniles retained the larval midlateral pigmentation, indicating the presence of midlateral pigmentation in the leptocephali. The larvae resemble those of *Taenioconger* in this respect, but the higher myotomal counts (170-208) of the larvae of the *Taenioconger* spp. help to distinguish the larvae of *Gorgasia punctata* with lower myotomal count (137-159). The myotomal counts (137, 152, 159) of the larvae of *Gorgasia* closely agree with the adult vertebral counts (140-155) of *G. punctata*. In advanced metamorphic stages of larvae of *G. punctata*, the tubular nostril is distinct and separate from the upper lip as in the adults. The larvae also bear a close resemblance to those of muraenids in their body shape and the caudal fin, but the absence of the midlateral series of melanophores in muraenids rules out the possibility of mistaking them for muraenid larvae.

Material Examined.— 4 specimens, 67-95 mm TL. Pacific coast of Mexico: SIO 61-248(1), 75-249(3).

Description (based on 3 specimens, 67-95 mm TL).—Body elongate; a series of midlateral melanophores beginning at myotome 11 to end of body; a paired series of melanophores on ventral side beginning at myotome 9 to end of body; a series of 2-4 melanophores on upper jaw and another similar series on heart region; a series of very small melanophores at base of dorsal, caudal, and anal fin rays. Preanal distance 85-87%; predorsal distance 28-33%; head 6-7%; greatest depth 11-13%; total myotomes 137-159; preanal myotomes 118-123; last blood vessel at myotomes 67 and 74; tooth formula $\frac{1+(7-10)+(12-17)}{1+(8-11)+(6-10)}$.

Metamorphic and Juvenile Forms (Table 1).—No metamorphic forms were obtained. The midlateral larval pigmentation disappears early in juveniles, and advanced stages of juveniles do not have any trace of midlateral melanophores, unlike those of the *Taenioconger*. Juvenile pigmentation appears as patches of brown spots on the anterior dorsal part of the body, and as uniform brown dots on the ventral and posterior part of the body. No development of black pigment is seen in any part of the viscera.

The changes undergone in body proportions are similar to those of the larvae of *Taenioconger*.

Distribution (Fig. 6).—The adults and larvae are distributed from Cabo San Lucas to the Gulf of Panama. The larvae were collected in April.

Gorgasia obtusa (Garman) 1899
Figures 5F1, F2, 6

Adults of this species are not yet known. This larva was described in an earlier account (Raju 1974) as *Gorgasia* sp. (SIO 70-362). Garman (1899) described a similar larva as *Atopichthys obtusus*. Since the myotomal counts, pigmentation, and tubular nostril separate from the lip of the larva agree with *A. obtusus*, I assigned this species to *G. obtusa*.

Description (based on 1 specimen, 115 mm TL).—Body elongate; a series of midlateral melanophores; a paired series of melanophores on the ventral side; a series of small melanophores at the base of dorsal, caudal, and anal fin rays. Predorsal distance 10%; preanal distance 26%; head 8%; greatest depth 15%; total myotomes 121; preanal myotomes 55; last blood vessel at myotome 49.

Metamorphic and Juvenile Forms.—The larva was in the early stages of metamorphosis.

Distribution (Fig. 6).—The larva was collected off the coast of Panama.

SUBFAMILY CONGRINAE

Gnathophis catalinensis (Wade) 1946
Figures 7A-H, 8

Literature.—*Rhynchocynba* (*Gnathophis*) *catalinensis* was first described by Wade (1946) from Catalina Island. The adults attain a maximum size of about 40 cm, and burrow rapidly in the sand with the tail (Fitch and Lavenberg 1968). The larvae of *G. catalinensis* are identified for the first time in this account.

Identification.—The larvae were identified with the help of a small juvenile, metamorphic form, and the agreement of myotomal counts (124-132) of the larvae with the vertebral count (130) of one adult. The larval characters also agree with those of *Gnathophis* described by Castle (1963, 1968, 1969b) and Castle and Robertson (1974). The distinguishing features of the larvae of *Gnathophis* are the absence of midlateral pigmentation and the presence of a blunt tail and a crescentic patch of pigment below the eye. The iris is silvery in fresh or recently preserved specimens, but the silvery pigment fades with time. The larvae could be confused with those of *Ariosoma*, especially during metamorphosis, due to the striking similarity in the absence of midlateral pigment and presence of blunt caudal fins. The crescentic pigment patch below the eye in *Gnathophis* larvae distinguishes them from those of *Ariosoma*.

Material Examined.— 47 specimens, 55-140 mm TL. Baja California and Gulf of California: LACM 9829-14(1), 30196-14(1), 30025-4(1), 9667-6(4), 9667(3), 9659-15(1), 9658-5(1), SIO 60-459(1), 75-569(5), 67-61(5), 68-91(2), 57-41(2), 63-275(1), 63-280(1), 63-276(1), 63-282(2), 64-36(1), 63-281(1), 65-425(1), 63-274(1), 63-284(1), 65-213(1), 63-277(1), 63-274(1), 63-278(2), 63-279(1), 63-285(1), 63-41(1). Colombia and Galapagos: SIO 55-258(1), 67-154(1).

Description (based on 13 specimens, 55-140 mm TL).—Body elongate; a crescentic black (silvery in fresh specimens) patch below and above eye; a group of dotlike melanophores in heart region; a series of large melanophores on ventral side beginning at myotome 8 to the vent; a series of densely packed melanophores at base of anal, caudal, and posterior dorsal fin rays. Preanal distance 75-91%; predorsal distance 60-89%; head 5-9%; greatest depth 11-13%; total myotomes 128-133; preanal myotomes 83-110; caudal fin rays 3 + 3 = 6; last blood vessel at myotome 45-47; tooth formula $\frac{1+(4-19)+(10-22)}{1+(4-11)+(9-13)}$.

Metamorphic and Juvenile Forms (Table 1).—Larval pigmentation at the base of anal fin persists into metamorphic and juvenile stages. The snout in the metamorphic forms becomes blunt and assumes a hooklike shape. The juveniles have a relatively large head. Patches of densely packed melanophores develop on the dorsal half of the myotomes and below the midlateral line. The ventral and ventrolateral surface is free of pigmentation. Black pigment appears on the stomach and brown pigment on the anterior part of the intestine in the juveniles.

The reduction (27.0%) in the total length is low. The increases in the snout length (4.0%) and the eye (3.0%) are the highest. The increase in head length (13.3%) is moderately high.

Distribution (Fig. 8).—The larvae, metamorphic forms, and juveniles are distributed from Catalina Island to the Gulf of California, and disjunctly from the Galapagos Islands to Colombia. Larvae were collected in all months of the year except April, July, September, October, and November. The larvae probably do not occur in shoals, as the collections usually contained 1-5 larvae only, unlike those of *Hildebrandia*, *Taenioconger*, and *Ariosoma*.

Discussion.—Castle (1963) suggested that *Atopichthys cingulus* of Garman could possibly be the larva of *G. catalinensis*. As pointed out earlier, it is not the larva of *G. catalinensis*, but a metamorphic form of *Ariosoma gilberti*. *Atopichthys cingulus* does not posses the black patch below the iris. The ventral pigmentation and other features are characteristic of the larvae of *Gnathophis*.

Hildebrandia nitens (Jordan and Bollman) 1890
Figures 9, 10

Literature.—This is a small eel resembling *Bathycongrus*, but it differs in having a relatively slender body. The tail is very attenuate with a black border on the median fins. It was first described by Jordan and Bollman (1890) from the Pacific coast of Panama

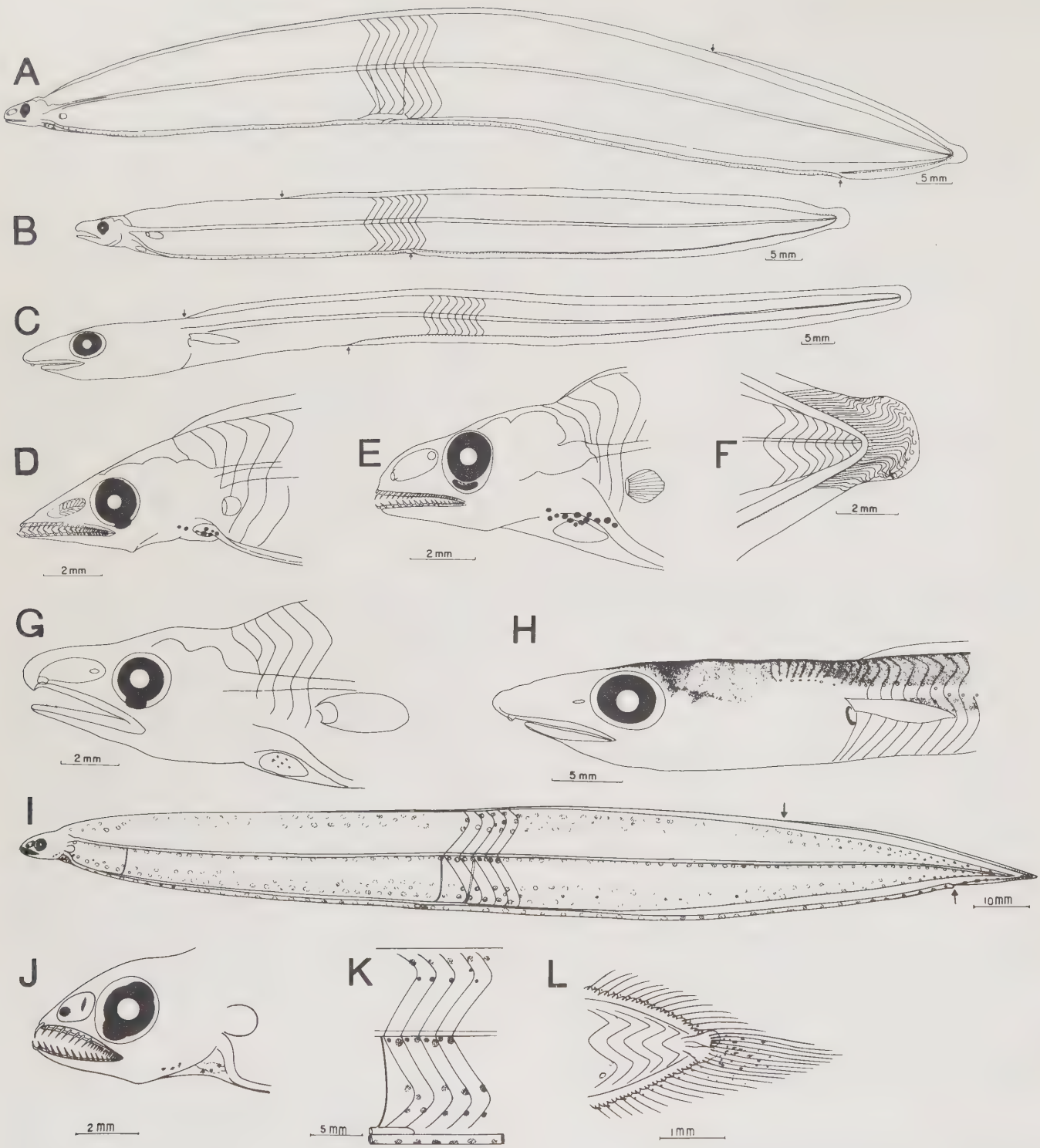

Figure 7.—Early life history of *Gnathophis catalinensis* and larva of *Bathycongrus varidens*. *Gnathophis catalinensis*: A. Fullgrown larva; B. metamorphic form; C. late juvenile; D. head of early larva; E-F. head and caudal end of fullgrown larva; G. head of metamorphic form; H. head of late juvenile. *Bathycongrus varidens*: I. Fullgrown larva; J-L. head, midbody, caudal end of fullgrown larva.

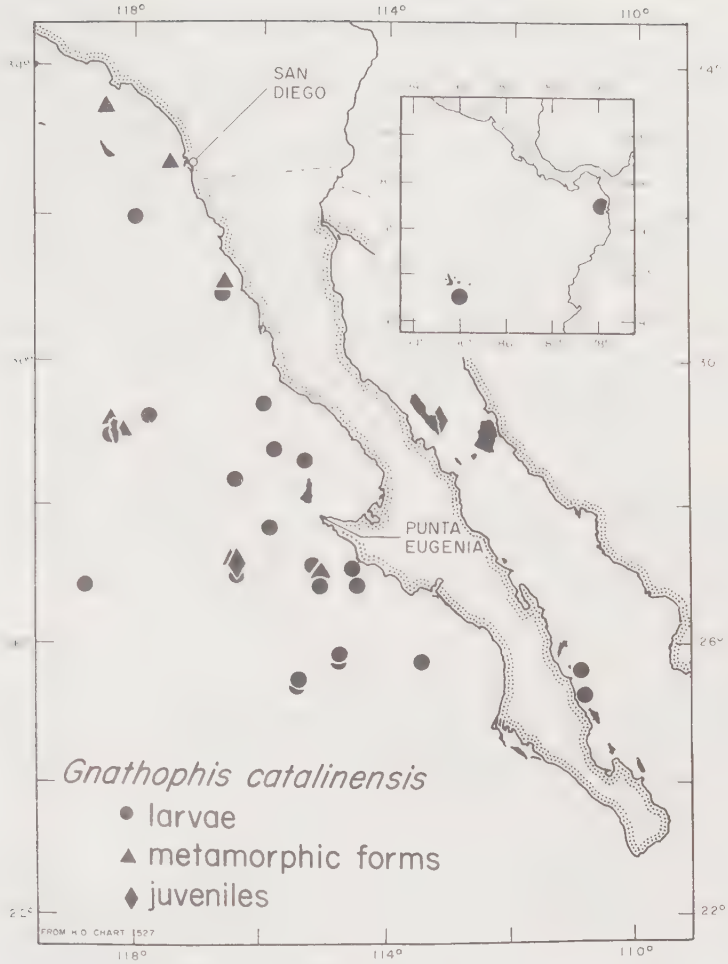

Figure 8.—Distribution of *Gnathophis catalinensis* based primarily on SIO collections.

as *Ophisoma nitens* and later reported as *Congermuraena nitens* (Jordan and Evermann, 1896). Jordan and Evermann (1927) erected the genus *Hildebrandia* consisting of *Congermuraena flava* Goode and Bean 1896. Smith and Kanazawa (1977) synonymized *Congrina gracilior* Ginsburg (1951) and *Congromuraena guppyi* Norman (1925) with *Hildebrandia* and redescribed *Hildebrandia* (*Congromuraena*) *guppyi*.

Identification.—Larvae were identified on the basis of the characteristics of the metamorphic and juvenile forms. The larvae possess a midlateral series of melanophores which disappear in both the metamorphic forms and juveniles by gradually sinking deeper into the musculature from the surface. The deep-seated pigment spots can be seen in the metamorphic and juvenile forms by clearing the specimens with glycerine. The vertebral counts of adults, (30-32) + (138-150) = 168-182, agree with the myotomal counts (170-180) of the larvae.

Material Examined.—1,234 specimens, 35-140 mm TL. Baja California and Gulf of California: SIO 68-93(2), 60-97(1), 75-535(2), 65-158(5), 62-207(1), 63-934(1), 75-562(14), 60-90(1), 60-89(3), 63-920(9), 68-50(5), 60-87(1), 63-616(42). Mexico: SIO 62-51(1), 62-52(4), 63-864(13), 63-932(15), 75-555(12), 75-563(8), 73-249(115), 63-860(1), 75-549(110), 63-861(5), 63-503(1), 65-166(48), 63-504(17), 63-518(15), 63-246(2), 63-522(1), 63-526(8), 63-510(1), 63-923(4), 63-924(37), 75-557(1), 75-561(11), 63-857(16). Central America: SIO 63-1025(14), 63-926(2), 68-380(117), 63-853(22), 73-263(40), 63-1028(12), 63-964(2), 63-858(5), 63-856(7), 63-925(12), 63-929(17), 63-852(21), 63-927(7), 58-355(2), 63-851(60), 55-235(3), 63-836(17), 62-640(3), 63-839(5), 63-850(12), 64-198(3), 63-1083(1), 63-843(45), 63-838(17), 63-243(1). Colombia: SIO 63-841(7), 63-843(27), 62-387(5), 63-846(43), 63-842(5), 63-845(117), 63-847(2), 55-248(48).

Description (based on 14 specimens, 35-140 mm TL).—Body elongate; a series of midlateral melanophores on lateral surface beginning at myotome 14 to end of body; a paired series of melanophores on ventral side beginning at myotome 9 to vent; dusky black pigment at base of anal, caudal, and dorsal fin rays; a crescentic, dark patch below the eye; a series of 2-3 melanophores at angle of jaws, and another series of 3-4 melanophores near heart region. Preanal distance 79-92%; predorsal distance 32-44%; head 5-6%; greatest depth 9-13%; total myotomes 170-180; preanal myotomes 125-130; last blood vessel at myotome 45-49; caudal fin rays 4 + 4 = 8; tooth formula $\frac{1+(4-10)+(6-25)}{1+(4-16)+(4-10)}$.

Metamorphic and Juvenile Forms (Table 1).—The crescentic patch below the eye and the midlateral series of melanophores on

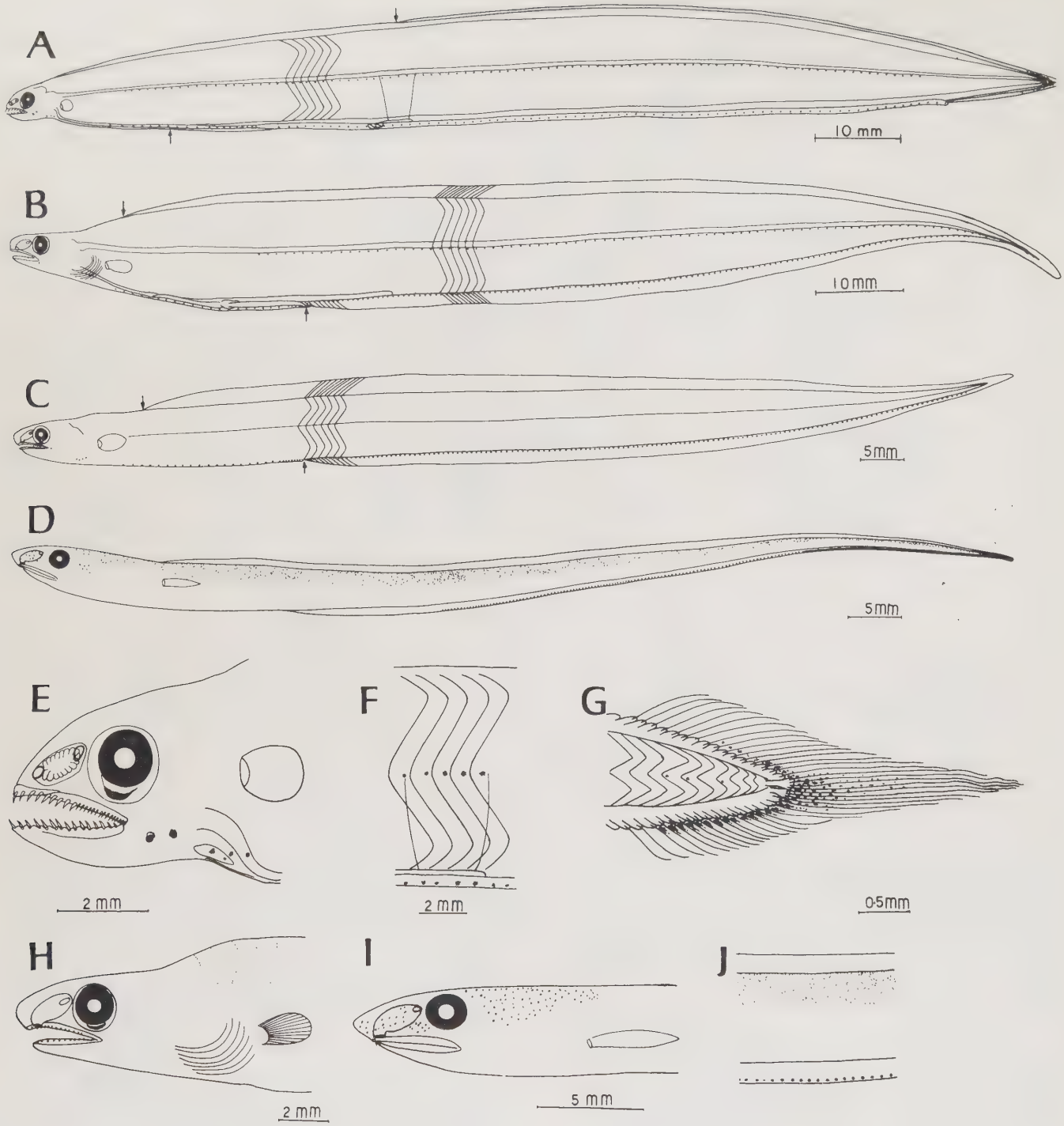

Figure 9.—Early life history stages of *Hildebrandia nitens*. A. Fullgrown larva; B. metamorphic form; C. early juvenile; D. late juvenile; E-G. head, midbody, caudal end of fullgrown larva; H. head of metamorphic form; I-J. head, midbody of late juvenile.

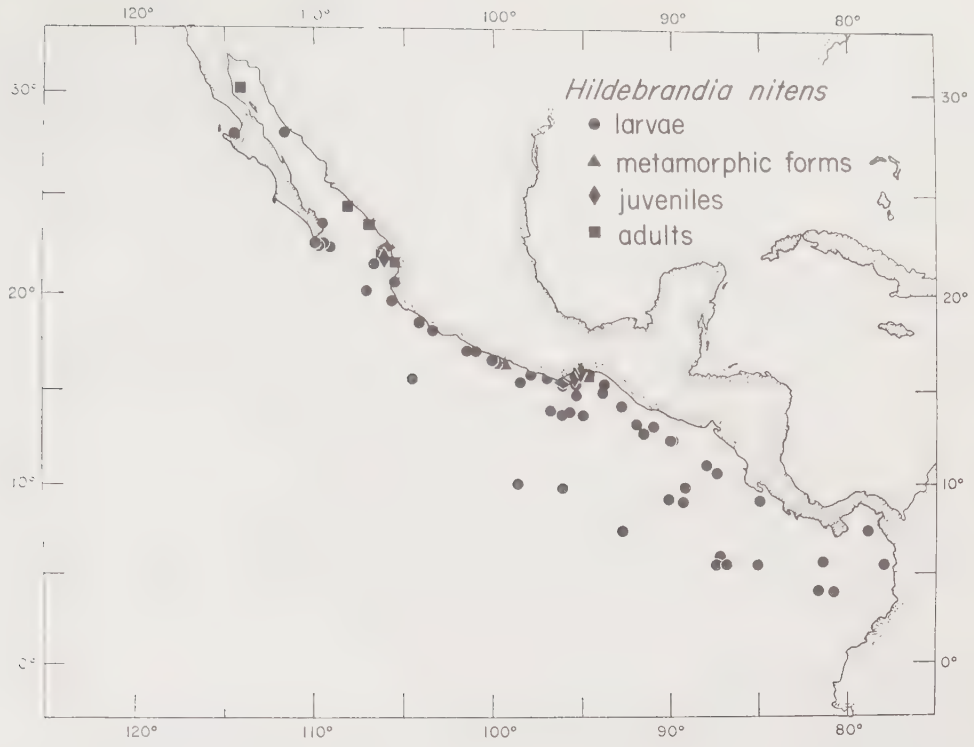

Figure 10.—Distribution of *Hildebrandia nitens* based primarily on SIO collections.

the surface disappear during metamorphosis. The juvenile pigmentation appears as minute brown chromatophores first on the upper half of the body above the midlateral line, and then below the midlateral line in later stages. The entire esophagus, anterior part of the stomach, and the peritoneum become black in juveniles.

The reduction (34.3%) in total length is moderate, but the reduction (8.4%) in body depth is one of the highest. The increases in head length (9.7%) and snout length (2.2%) are moderate. The increase (0.5%) in the eye size is low, as in heterocongrids.

Distribution (Fig. 10).—The larvae are found from the Gulf of California to the Gulf of Panama very close to the coastal waters. They were present in all months of the year except December; the minimum number collected was 2 in October; the maximum was 527 in May. Metamorphic forms were obtained in October, and the juveniles in January, March, May, June, and July. These are the most abundant of all the congrid larvae collected from the eastern Pacific. They seem to occur in shoals as the samples from some stations contain large numbers of larvae.

Bathycongrus macrurus (Gilbert) 1891
Figures 11, 12

Literature.—The species *Bathycongrus macrurus* is a small but relatively heavy-bodied eel with a tapering, pointed tail. They were described by Gilbert (1891) as *Ophisoma macrurum* from the Gulf of California, and Ogilby (1898) gave the name *Bathycongrus macrurus*.

Identification.—The larvae were identified on the basis of pigmentation of the metamorphic forms and the vertebral counts of adults. The vertebral counts (30-36) + (98-107) = 128-143 of 14 adults (195-265 mm TL) and 7 juveniles (103-140 mm TL) agree with the myotomal counts 139-151 of the leptocephali and metamorphic forms. The slightly lower vertebral counts are due to broken tails.

Material Examined.—90 specimens, 45-145 mm TL. Baja California and Gulf of California: SIO 68-74(14), 68-92(10), 65-253(3), 63-865(11), 63-920(5), 63-959(3), 68-50(16), 63-933(1), 63-864(5). Mexico to Colombia: NMFS ETP 12.032(1), SIO 63-851(1), 69-497(1), 63-838(5), 62-639(2), 63-841(1), 63-842(2), 63-843(6), 63-845(2), 63-846(1).

Description (based on 14 specimens, 45-145 mm TL).—Body elongate; a series of midlateral melanophores beginning at myotome 10 to end of body; a crescentic patch below iris and another above pupil; a series of paired melanophores on ventral side beginning at myotome 9 to vent; a pair of melanophores on operculum and another pair in heart region; a series of minute melanophores at base of dorsal, caudal, and anal fins. Preanal distance 88-95%; predorsal distance 62-77%; head 4-6%; greatest depth 11-13%; total myotomes 139-151; preanal myotomes 110 -125; last blood vessel at myotome 49-56; caudal fin rays 5 + 5 = 10; tooth formula $\frac{1+(7-11)+(6-30)}{1+(6-10)+(6-20)}$.

Metamorphic and Juvenile Forms (Table 1).—The larval midlateral pigmentation is retained into late juvenile stages. The esophagus, stomach, and anterior part of the intestine become black in the juvenile stages. Some metamorphic forms contained euphausiids in their stomachs.

The reduction (42.6%) of total length is high, but the body depth reduction (5.0%) is one of the lowest. The increases in the head length (5.5%) and eye size (1.0%) are low.

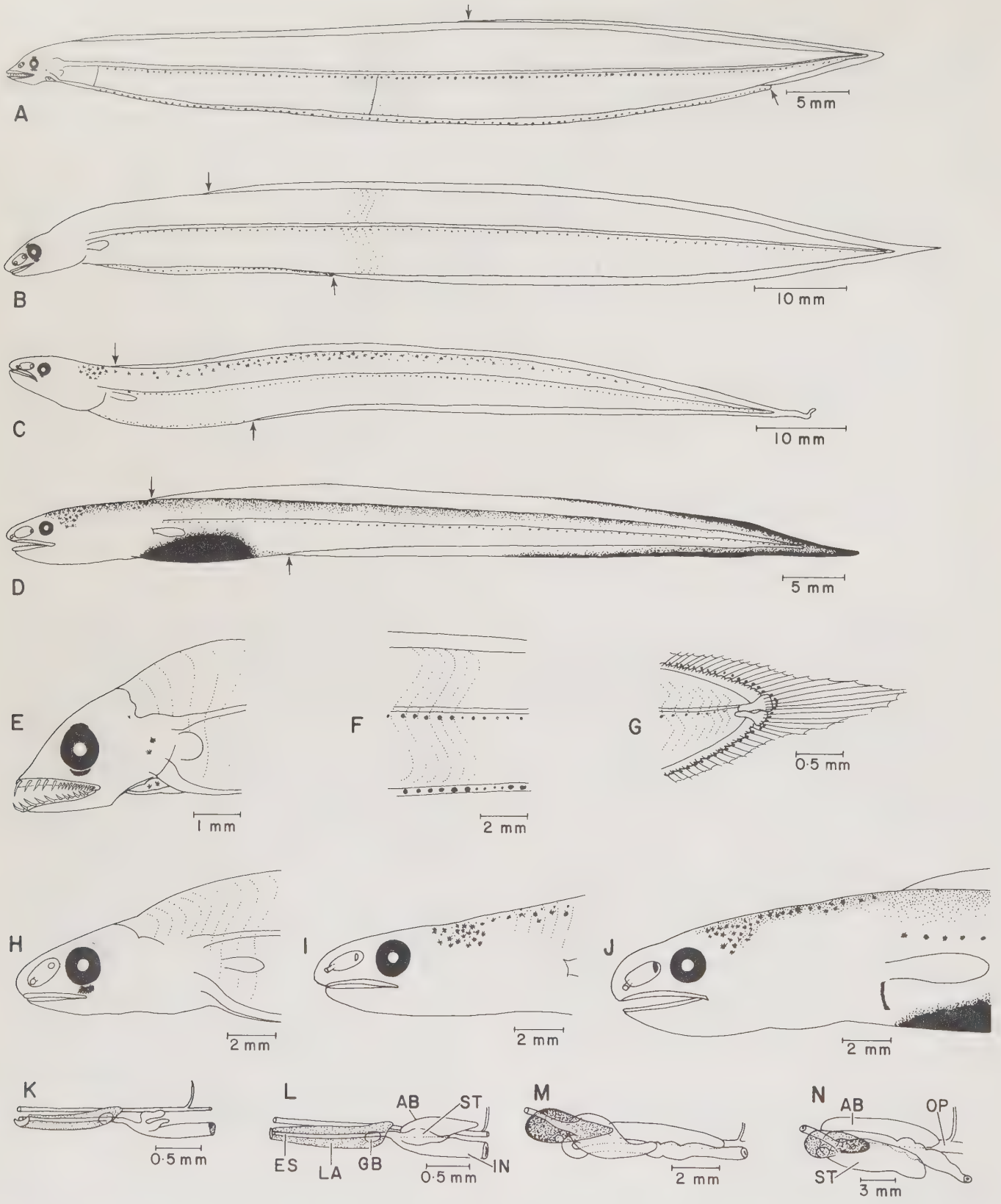

Figure 11.—Early life history stages of *Bathycongrus macrurus*. A. Larva; B. metamorphic form; C. early juvenile; D. late juvenile; E-G. head, midbody, caudal end of larva; H-J. heads of metamorphic, early and late juvenile forms; K-N. stages in the development of stomach, liver, airbladder, and gall bladder from larval to juvenile stages. Abbreviations: AB, air bladder; ES, esophagus; GB, gall bladder; IN, intestine; LR, liver; OP, opisthonephros, ST, stomach.

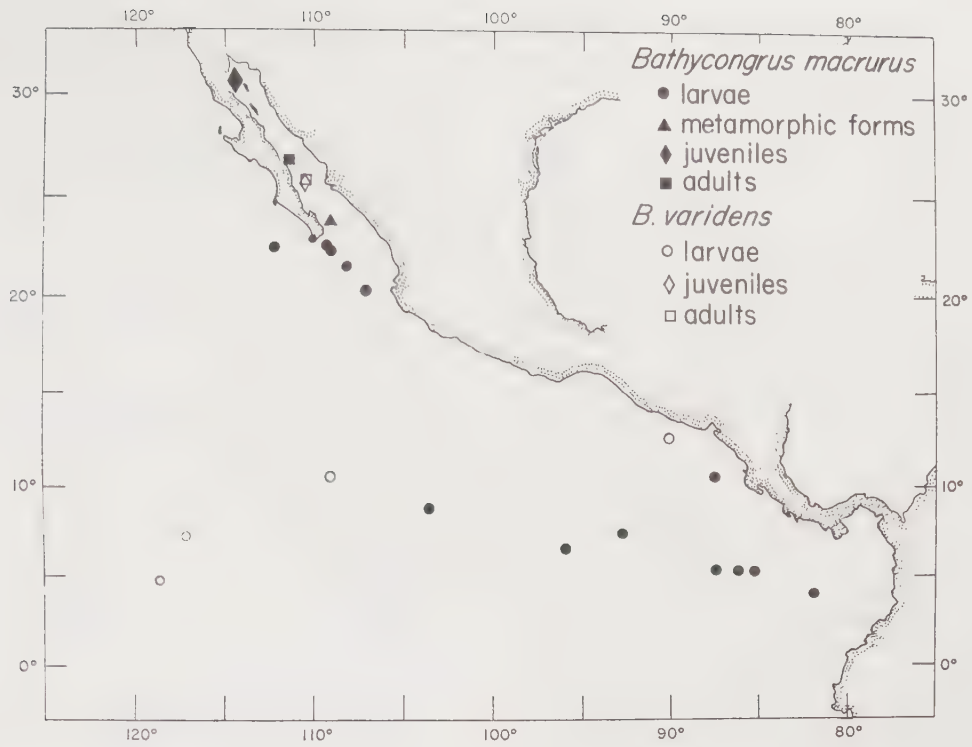

Figure 12.—Distribution of *Bathycongrus macrurus* and *B. varidens* based primarily on SIO collections.

Distribution (Fig. 12).—The few larvae collected (only 62) occur from the Gulf of California to Panama in the months of February, May, June, and August; the maximum number obtained was 26 in June. Metamorphic forms were collected in July, and juveniles were collected in January.

Bathycongrus varidens (Garman) 1899
Figures 7I-L, 12

Literature.—Garman (1899) described *Uroconger varidens* from the Pacific coast of Panama. A study of the dentition and anatomy of the juveniles and adults shows that the species is referable to *Bathycongrus*.

Identification.—The larvae were identified with the help of a juvenile (136.0 mm) and an adult (234.0 mm) which retained the characteristic pigmentation. The larval and juvenile pigmentation is in the form of three parallel rows on the lateral side. The myotomal counts (158-162) of the five larvae do not quite agree with the vertebral counts, (38-41) + (109-115) = 147-156, due to broken tails of the adults. Similar larvae with three lateral rows of melanophores were referred to *Congrina* (*Rhechias*) by Castle (1969a) and to *Rhechias* by Smith (1971). The upper and lower rows are double rows in *B. varidens*, whereas they are single in *Rhechias* spp.

Material Examined.—Seven specimens, 154-250 mm TL. Gulf of California: SIO 68-132(1), 68-128(1), 63-852(1), 63-8333(1), 75-214(2), NMFS ETP 11.072(1).

Description (based on 5 specimens, 154-250 mm TL).—Body elongate; a double row of circular melanophores on lateral side close to dorsal region of body and a similar row close to ventral region; a third double row in midlateral line; a single row on midventral region; a series of closely packed, small melanophores at base of median fin rays; a row of three melanophores in heart region and at angle of jaw; a crescentic patch above and below eye. Preanal distance 93-96%; predorsal distance 71-96%; head 4-5%; greatest depth 10-14%; total myotomes 158-162; preanal myotomes 136-143; last blood vessel at myotomes 54-56; caudal fin rays 5 + 5 = 10; tooth formula $\frac{1+8+(12-25)}{1+(6-9)+(7-9)}$.

Metamorphic Forms and Juveniles (Table 1).—Three double rows of melanophores on the side of the body are retained to the juvenile stage and even to the adult stages (240.0 mm) to some degree. Juvenile pigmentation appears as fine brown dots all over the body and margin of the median fins. Part of the esophagus and stomach become black.

The reduction (54.4%) in total length is high, and that of the body depth (6.3%) is moderate. The increase (16.5%) in the head length is the highest.

Distribution (Fig. 12).—The larvae are rare (only five) and were collected in the months of February, April, and May in the offshore waters from Guatemala outwards. The juveniles and adults were collected from the Gulf of California to Panama in January.

Discussion.—The characteristics of the species *varidens* do not agree with those of *Uroconger*. The body is robust and the vomerine teeth are a triangular patch, not uniserial as in *Uroconger*. The stomach is black as in *Bathycongrus*, whereas it is unpigmented in *Uroconger*, which also has a very high (over 200) myotomal count.

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